REC'D 07 AUG 2003
WIPO PCT

21 JAN2005

Patent Office
Canberra

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

I, LEANNE MYNOTT, MANAGER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002950316 for a patent by POLWOOD AUSSIE BARK PTY LTD as filed on 22 July 2002.

WITNESS my hand this
Thirtieth day of July 2003

LEANNE MYNOTT
MANAGER EXAMINATION SUPPORT
AND SALES

P/00/009
Regulation 3.2

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: **"PLANT GROWTH MEDIUM"**

The invention is described in the following statement:

TITLE

"PLANT GROWTH MEDIUM"

FIELD OF THE INVENTION

This invention is concerned with plant growth media using waste materials primarily of vegetable origin.

The invention is concerned, particularly, but not exclusively, with the manufacture of plant growth media from sawmill waste, with or without other organic waste materials.

BACKGROUND OF THE INVENTION

Disposal of sawmill waste including bark, woodchips and sawdust has become a problem for sawmill owners since environmental pressures ceased the practice of burning sawmill waste.

It is known to use sawmill waste in the manufacture of plant growth media but this can be quite problematic particularly in the case of conifer species because of a low pH arising from tannins or phenolic materials therein. A low pH environment in a plant growth medium can kill plants or at least retard plant growth.

Another problem with the use of untreated sawmill waste is the prospect of distributing over a very wide area, insect pests, wild yeasts and other microorganisms and plant pathogens harmful to plants.

It is widely known to produce plant growth media by mulching materials such as sawmill waste alone or mixed with other materials by forming covered heaps and allowing natural fermentation to cause a temperature rise within the heap to kill at least some of the microorganisms,

plant pathogens and insect pests which may be contained therein. A serious disadvantage of this process is that not all microorganisms and plant pathogens are killed in this process and indeed human pathogens eg. Legionnaires Disease can be transmitted to humans from these mulched materials of vegetable origin. Probably the greatest disadvantage however with naturally fermented mulching processes is that it takes from two to three months or even longer for the fermentation or mulching cycle to be completed, and very large storage areas are required to build the heaps or windrows in which the fermentation process occurs.

European Patent No 0360447 describes a process for treatment of comminuted bark in sealed bags by microwave radiation to kill insect pests, yeasts and other microorganisms but does not address the problem associated with low pH in the resultant medium. This process is both energy and capital intensive.

Australian Patent No 520873 describes the treatment of fresh green bark particles containing sap from which at least some phenolic materials are removed by treatment with an aqueous alkaline material such as sodium sulphite, sodium bisulphite, sodium metabisulphite, sulphur dioxide, ammonium sulphates, sodium carbonate, sodium bicarbonate, potassium bicarbonate, sodium hydroxide, potassium hydroxide, ammonium hydroxide, ammonium carbonate and/or ammonia. After extraction of phenolic materials, conditioning materials such as vermiculite and expanded perlite are added to the treated bark particles and, if required, fertilising materials may also be added to contribute nitrogen, phosphorous and

potassium. The process described is a counter-current flow process wherein the spent liquor is extracted to reclaim phenolic materials used together with formaldehyde or the like as bonding agents in particleboard or the like. The process is carried out at a temperature above ambient and requires the processing time of about two hours to remove the phenolic materials to the desired degree.

European Patent Application 014355 describes a composted plant growth medium wherein comminuted bark is treated with super heated steam and aqueous ammonium or nitrate solutions to provide a soluble nitrogen source. The product so produced has a moisture content of 60-70 weight percent which is then fermented at a pH of 6 to 7.5 for three months. Phosphorus and potassium compounds can be added if necessary to obtain the desired end PK ratio.

Canadian Patent No 1203991 describes a process wherein comminuted bark is sterilised in air at 300-700°C, further comminuted and then is treated with a solution of calcium chloride, then a solution of soluble sodium or potassium silicate at a pH of 6 to 7. The resultant product is described as an inert soil conditioner to improve plant growth qualities in clay soils and prevent shrinkage and cracking.

German Patent Application 33344540 describes a soil conditioner made by cleaning, comminuting, heat treating bark particles to 130°C with subsequent drying at 500 to 550°C to produce a sterile product with very low moisture content and a very long shelf life even when other plant nutrients are added.

United States Patent No 4804401 describes a complex apparatus and process for producing a soil conditioner with a phosphorous fertilising effect by reacting a phosphate rock with an acidic organic reaction mass to produce a phosphate containing organic medium.

German Patent No 3040040 describes a soil conditioner produced by grinding conifer bark to a fine particle size and then mixing with aqueous ammonium bicarbonate to give a mixture containing from 70 to 80 weight percent of water and then composting the mixture for three months.

Australian Patent Application 50101/90 describes a soil substitute comprising shredded and composted bark mixed with stone, aggregate and siliceous sand particles. The tree bark is ground and screened, mixed with graded aggregate and siliceous sand particles, water and minor minerals such as zeolite, kaolite, entonite, etc., and trace elements as required. The mixture is then composted in windrows at a temperature of 42 to 60°C to produce a soil substitute product with a final water content of 40 to 60 weight percent.

Japanese Patent Application 90-118773/16 describes a composite soil conditioner comprising peat bark compost, vermiculite, rigid polyurethane foam granules, cow dung manure, calcine chaff, a slow release composite fertiliser, silica clay, a bacterial inoculant, ammonium nitrate, and calcium superphosphate. This soil conditioner is used to regenerate old growing soils by using a mixture of 1 to 3 to 1 to 4 of the conditioner with the old soil.

International Publication No WO 91/02778 describes a sterile

plant growth medium particularly suited to delicate aerophytes such as orchids or the like. The process described comprises a batch process wherein comminuted bark comprising an exogenous portion adhered to an endogenous portion is boiled in the presence of an alkaline material such as powdered limestone, powered dolomite or a mixture thereof to kill heat labile plant pathogens and insect pests and to produce a pH neutral layer on the outside of the bark granules. The heated, chemically treated bark granules are then immersed in water at ambient temperature or lower to cause separation of the endogenous and exogenous portions of the bark and the exogenous portion is collected and dried to form a sterile plant growth medium.

International Publication No WO 95/03371 describes a process for the manufacture of a sterilised peat moss alternative wherein the endogenous bark particles discarded from the process of International Publication No WO 91/02778 referred to above, are subjected to a milling action whilst having a high moisture content between 20 to 50 wt % or higher. The coarse fibrous material obtained is similar to a coconut fibre or relatively dry peat moss. The fibrous mass produced by the shredding operation is then dried to reduce the moisture content to between 10 to 20% and is compressed and bagged in hermetically sealed plastic bags to maintain moisture content and sterility in the product.

The prior art processes described above all suffer from one or more disadvantages. Composted materials for example, require a high moisture content, typically in the range 50 wt % to 80 wt % to support

bacterial and/or enzymatic digestion in an exothermic reaction at temperatures of between 40° and 60 to 80°C for extended periods of time, typically about three months. Other chemically treated materials are typically performed as batch processes which are labour intensive and otherwise generate spent treatment liquors which cannot readily be disposed of without costly extraction or treatment processes to produce an environmentally acceptable waste. The product of these processes is typically very dry with a low moisture content below 15%.

Accordingly, there is a need for rapid, high volume continuous process for producing a sterile plant growth medium, which process is both cost effective and is environmentally acceptable.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a method for sterilization of organic media, said process comprising the steps of:-

introducing comminuted organic media into an inlet port of an inclined conveyor mechanism containing a body of heated water;

submerging said organic media in said body of heated water for a predetermined period of time to kill microorganisms, insects, plant and animal parasites and the like whilst transporting said media towards an outlet port of said conveyor mechanism; and

at least partially dewatering said organic media to a predetermined moisture content.

The comminuted organic media may comprise material of

vegetable or animal origin such as sawmill waste including sawdust, bark and woodchips, peat, spent mushroom compost, animal or chicken manure, waste vegetables or vegetable scraps, meat or bone meal of animal origin or the like or selected combinations thereof.

Suitably said body of water is heated to a temperature in the range 85° to 125°C.

Preferably said body of water is heated to a temperature in the range 100° to 110°C.

The organic media may be comminuted by any suitable means such as a hammermill or the like.

The organic media suitably is comminuted to a particle size where substantially all the comminuted media passes through a 12mm screen.

If required, the body of water may contain a chemical treatment composition selected from a pH modifier, plant nutrients, pesticides, microbicides, parasiticides, fungicides or the like.

The sterilization process may be performed, at least partially, under a pressure greater than ambient air pressure.

The organic media may be at least partially dewatered in said conveyor mechanism adjacent an outlet port thereof.

If required, the organic media may be at least partially dewatered under the influence of mechanical pressure.

Alternatively, or additionally, the organic media may be at least partially dewatered in a rotary dewatering apparatus.

Suitably the organic media may be at least partially dewatered under the influence of heat.

The organic media may be at least partially dewatered by evaporation at ambient temperature and pressure.

After treatment, the organic media is packaged in hermetically sealed containers to maintain a substantially sterile state free from contamination by microorganisms, insects, parasites, plant and animal pathogens and the like.

As used herein, the term "sterilization" as it applies to treatment of organic media is intended to embrace a treatment method to substantially eliminate or deactivate contaminants such as microorganisms, insects, parasites, plant and animal pathogens or the like.

According to another aspect of the invention there is provided an apparatus for sterilization of organic media, said apparatus comprising:-

a conveyor in the form of a screw auger rotatably housed in a tubular body, said conveyor being inclined with an upright inlet port located at a lower end of said tubular body and an outlet port at an upper end of said tubular body;

drive means for said screw auger;

heating means to heat a body of water located, in use, in said tubular body; and,

dewatering means located adjacent said outlet port, said dewatering means, in use, at least partially dewatering organic media in the region of said outlet port.

Suitably said inlet port comprises an upright tubular member in fluid communication with said lower end of said tubular body.

Preferably, said inlet port, in use, is able to accommodate portion of a body of water located within said conveyor with an upper surface of said portion being located above a feed end of said screw auger to form a liquid seal between said inlet port and a bore of said tubular body.

If required, the inlet port may include feed means to assist in directing buoyant organic media towards said feed end of said screw auger.

The inlet port may include means to meter water into said conveyor.

The inlet port may include means to meter one or more chemical treatment compositions into said inlet port.

If required, the heating means may be located adjacent said lower end of said tubular body.

The heating means may be selected from a heat exchanger through which a heated medium is circulated or it may comprise one or more electrical heating elements.

Preferably, said heating means comprises a steam injection nozzle.

The dewatering means may comprise a region of tubular body having a plurality of apertures therein through which to drain water in use.

Suitably, a collection means is associated with said plurality of apertures to collect drained water and return said drained water to said tubular body.

The dewatering means may comprise a region of said screw auger wherein the pitch of said auger is reduced to cause, in use, compression of organic material to assist in dewatering thereof.

Alternatively, the dewatering means may comprise a region of said conveyor where the respective diameters of said screw auger and an adjacent region of said tubular body are reduced to cause, in use, compression of said organic material to assist in dewatering thereof.

If required, the dewatering means additionally may comprise a rotatable screen or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and put into practical effect, reference will now be made to preferred embodiments described with reference to the accompanying drawings in which:-

FIG. 1 shows schematically an isometric view of one form of the apparatus;

FIG. 2 shows a cross-sectional side elevation of the apparatus of FIG. 1;

FIG. 3 shows an enlarged partial cross-sectional view of a lower end of the apparatus of FIGS. 1 and 2; and,

FIG. 4 shows an enlarged partial cross-sectional view of an upper end of the apparatus of FIGS. 1 and 2.

DETAILED DESCRIPTION OF THE DRAWINGS

As shown in FIG. 1, the sterilizing apparatus comprises an

inclined screw auger conveyor 1 mounted on a support frame 2. Adjacent the lower end of conveyor 1 is an upright tubular inlet port 3 having an open hopper mouth 4 at its upper end. The lower end of inlet port 3 is in fluid communication with the interior of the lower end of conveyor 1.

Mounted on top of conveyor 1 is a liquid holding tank 5 having access hatches 6 in a top wall thereof, stairs 7 and gangway 8 provide access to hatches 6 and hopper mouth 4.

At the elevated end of conveyor 1 is an outlet port 9 and a support bracket 10 in which the shaft 11 of a screw auger (not shown) is rotatably journalled. Just behind outlet port 9 is a collection chamber 13 to collect excess water from dewatering region 12 and return the water so collected to a sediment tank 14 via conduit 15. An overflow conduit 16 is coupled between sediment tank 13 and holding tank 5.

FIG. 2 shows a cross-sectional side elevational view of the apparatus of FIG. 1 and for the sake of simplicity like reference numerals are employed for like features.

Shaft 11 of screw auger 18 extends through a waterproof gland bearing 17 mounted on the lower end of the tubular body of conveyor 1 and is adapted for attachment thereto by a variable speed drive motor/gearbox combination (not shown).

Mounted within inlet port tube 3 is another screw auger 19 driven by another variable speed drive (not shown) coupled to shaft 20. The lower end of shaft 20 is rotatably journalled in a bracket 21 located within inlet port tube 3.

FIG. 3 shows an enlarged part cross-sectional view of the holding tank 5 shown in FIGS. 1 and 2.

The floor of holding tank 5 is effectively an upper portion 22 of the tubular body of conveyor 1 and formed in this region 22 are grated apertures 23 to allow fluid communication between tank 5 and the interior of conveyor 1.

FIG. 4 shows an enlarged part cross-sectional view of the upper end of conveyor 1.

Formed in the wall of the tubular body of conveyor 1 in the region of collection chamber 13 are slotted apertures 24 through which water drains in the dewatering region 12. To assist in dewatering of comminuted organic material in this region, the mass of treated material being conveyed by auger 18 may be subjected to mechanical compression by a tapering of the conveyor tube and screw auger as shown in phantom at 25. Alternatively, the pitch between the last several flights of the auger 18 may be reduced to cause compression in the mass of material in the dewatering region 12.

Mounted on shaft 11 for rotation therewith is a wiping blade 26 to assist in egress of the dewatered mass via outlet port 9 by preventing compaction in the mass of dewatered material.

Although the apparatus and method of the invention may be employed to sterilize a variety of comminuted organic materials a method now will be described for the manufacture of a sterilized plant growing medium utilizing sawmill waste as a feedstock.

Sawmill waste is predominantly bark having an exogenous portion and an endogenous sapwood portion together with varying quantities of sawdust and timber chips.

Initially, the sawmill waste is processed by a hammermill or the like to reduce the waste to a size where substantially all of the milled waste will pass through a 12mm screen. Typically, the particulate material comprises about 85% in the range of 3mm to 12mm.

Before commencing the treatment process, water is introduced into conveyor 1 either via holding tank 5 or via inlet port tube 3. When the water has reached a desired level about halfway up inlet port tube 3, but below the drainage apertures 24 in dewatering region 12, the water is then heated to boiling by introducing steam via hollow shaft 11 having apertures (not shown) spaced along the lower half of shaft 11. Because of the head of water (between 2 to 3 metres) in the conveyor tube, a temperature of between 105° and 110°C can be maintained in the body of water in conveyor 1 and communicating holding tank 5. The level of water is maintained in the apparatus by metering make up water into holding tank 5 or into inlet port 3 to compensate for losses in the treated sawmill waste issuing from the outlet port 9.

Because the bark portion of sawmill waste, and particularly, in respect of coniferous barks, is quite acid due to a high level of phenolic compounds (tannins) it is desirable to partially neutralize these surface tannins as many plants are sensitive to excessively acid or alkaline growing media. The addition of dolomite or lime in a powered form by a metering

feeder (not shown) via inlet hopper 4 at a rate of about 25kg per 10 cubic metres of radiata pine bark will produce a treated plant growth medium having a surface pH in the range of 6.0 to 6.5 although it is preferred to maintain pH in the range 6.2 to 6.4 for the sake of product consistency.

Plant nutrients containing nitrogen, phosphorus and potassium compounds, minerals and trace elements may also be added in a liquid, slurry or dry powder form by a suitable metering means (not shown).

Milled and screened sawmill waste is then added to the inlet hopper mouth 4 by a conveyor such as a screw auger, belt conveyor or by a front-end loader. Because the particulate sawmill waste is very buoyant, screw auger 19 is necessary to urge the particulate feed below the water level in inlet port 3 and into the region of screw auger 15.

With screw auger 15 rotating at a speed sufficient to give a submerged residence time of from 15 to 20 minutes the particulate mass is transported below the level of water in the tubular body of conveyor 1 towards outlet nozzle 9. As the mass of treated sawmill waste emerges from below the water level in conveyor 1, it passes through dewatering region 12 wherein the combined effects of friction between adjacent particles causing a tumbling effect and compression in the tubular body cause excess water on the surface of the particulate material to flow under the influence of gravity via apertures 24 for collection in collection chamber 13. Excess water so collected then drains back to sediment tank 14 which can be pumped back into inlet port 3 or into holding tank 5 after fine particulate matter such as soil settles out. Alternatively, the excess water can be drained directly into

holding tank 5 or into the tubular body of conveyor 1 at a suitable position. Either way the apparatus does not pose an environmental threat with disposal of spent treatment water containing treatment chemicals otherwise being allowed to enter a stormwater drain or the like.

The dewatering process may be assisted by compressing the mass of particulate material in the dewatering region 12. This may be effected by altering the size of outlet port 9 to give rise to a back pressure in the screw auger 18. Wiper blade 26 is effective to prevent blockage of outlet port 9 due to compaction of particulate material by loosening the "plug" of compacted material above port 9 as it rotates with the shaft 11 of screw auger 18.

Particulate plant growth medium issuing from nozzle 9 typically has a moisture content of about 30 to 35%. For prolonged shelf life of packaged product it is desirable that the moisture content be retained above about 10% but below about 25%, preferably in the range of from 12 to 18%.

The optimum moisture content may be obtained by passing the particulate product through a rotating drain drier heated with steam or hot air. Alternatively, it may be spread out on a storage surface for a day or so depending upon prevailing weather conditions to enable evaporation of excess water.

It is important however, that the product is not allowed to dry out to a moisture content less than about 10% as it is very difficult to rehydrate for use. At the same time, if the product is allowed to dry naturally, it should not be left exposed for any more than about two days due to the

risk of reinfection from airborne bacteria, viruses and fungal spores or from regrowth of remnants of microbial populations remaining after the treatment.

The product is bagged in sealed plastic bags with a typical moisture content of about 15% and this permits a shelf life of a substantially sterile plant growth medium of many months.

It readily will be apparent to a person skilled in the art that the method and apparatus of the present invention may be modified or varied without departing from the spirit and scope of the invention.

For example, in the sterilization of peat harvested from the field, the nature of insect, parasite and microbial infestations will vary from one harvesting site to another, and moreover, the intended end use of the peat will largely dictate the manner and extent of its sterilization. In some cases the treatment water may contain an insecticide or parasiticide where mere exposure of the peat to water at elevated temperature is inadequate to kill insects or parasites of various species. Similarly, the residence time in the apparatus may be varied as required.

In order to accommodate a longer residence time of material in the apparatus according to the invention, the pitch of the screw auger may be reduced and/or the rate of rotation of the screw auger may be reduced. Alternatively, the length of the auger barrel may be increased.

Where a lengthened auger barrel is employed, at least that portion of the barrel extending beyond the level of water in the barrel portion of the conveyor may be heated by electric elements, steam or oil jackets or the like to maintain a heat input into material passing through the conveyor.

If required, the dewatering apertures may extend over the extended barrel portion whereby the material being sterilized can be extensively dewatered or partially dried by the combination of compressive forces and heat. For some materials such as plant growth media, the use of an extended heated conveyor barrel may permit the material issuing from the outlet port to be bagged either directly or after cooling.

In the case of spent mushroom compost, this may be treated directly without submergence under a body of heated water in the conveyor.

Similarly, freshly harvested peat may be treated directly by passing the material through the heated conveyor without submergence in a body of water therein by adjusting the moisture content of the feed material to a desired level and then relying on heating of the moist material and/or generation of steam therein by heat externally applied to the conveyor barrel.

Spent mushroom compost typically comprises an imported peat product. By sterilizing the spent product and adding nutrients as required, the mushroom compost can be recycled with considerable cost savings.

It is also considered that the apparatus may be suitable for treatment of animal bone and tissue means intended for use as an animal foodstuff to prevent or at least minimize the risk of disease transmission.

Vegetable waste sourced from municipal waste receiving stations, food processors and retail outlets can also be processed according to the apparatus and process of the invention to produce an animal feed supplement, plant growth medium or the like, either on its own or in combination with other particulate animal feedstuffs or plant growth media

respectively.

The treated product, whether of animal or vegetable origin, is resistant to decay and putrefaction and otherwise constitutes a value added product.

Depending upon the nature of the material to be sterilized and/or dried, it may be possible to heat the material in the conveyor barrel to temperatures in excess of 110°C by the use of a jacketed barrel having heated oil circulating therethrough.

In addition, the auger shaft may comprise a hollow tube through which a heating medium may be circulated. By employing a relatively large length:diameter ratio in the conveyor barrel and/or a relatively large diameter auger shaft, material passing through the auger can be subjected to a very extensive heating and/or drying treatment without compromising throughput efficiency.

Throughout this specification unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising" will be understood to imply the inclusion of a stated integer or group of integers or steps but not the exclusion of any other integer or group of integers.

DATED this Twenty-second day of July 2002.

POLWOOD AUSSIE BARK PTY LTD

by its Patent Attorneys

FISHER ADAMS KELLY

FIG 1

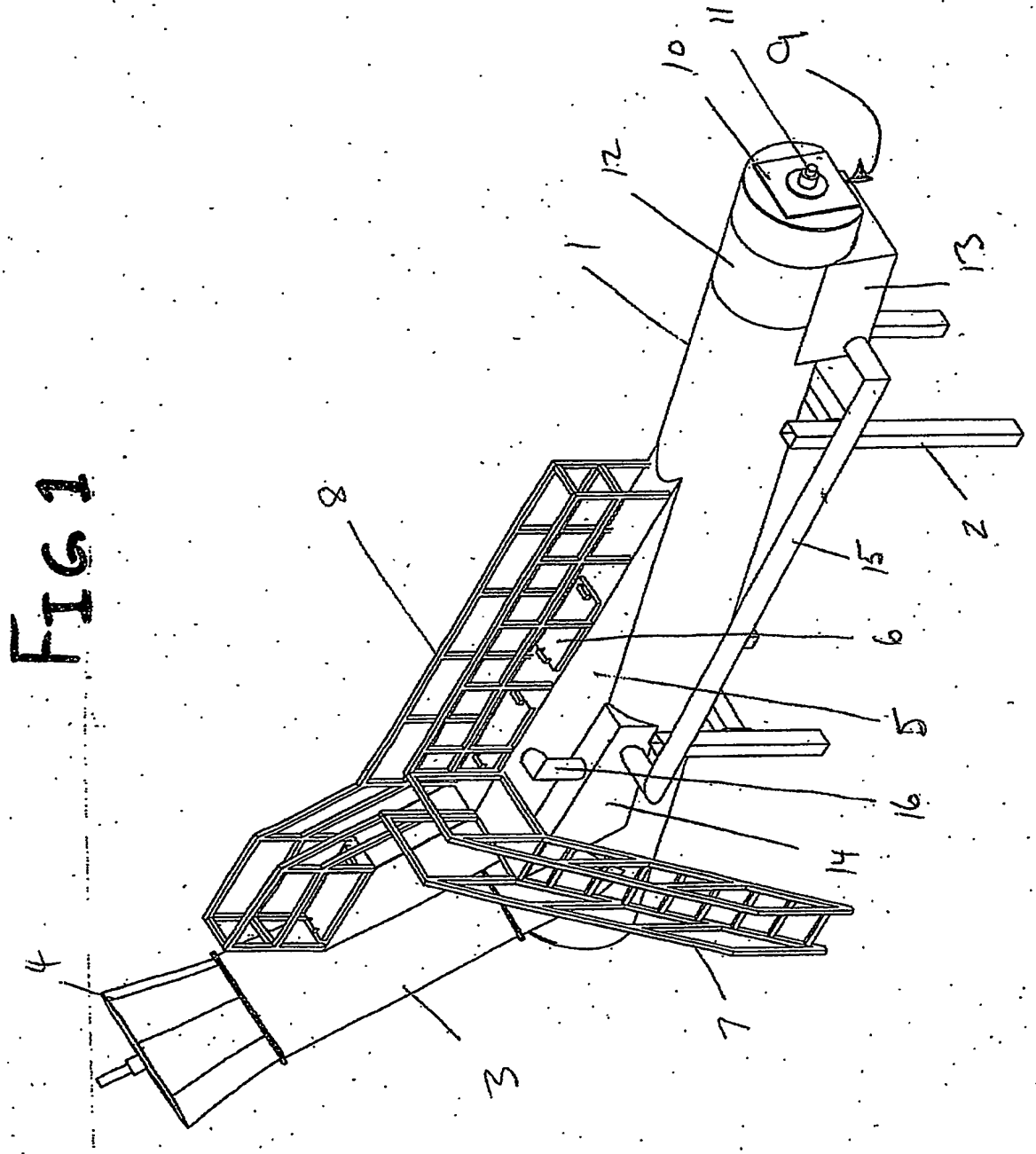


FIG 2

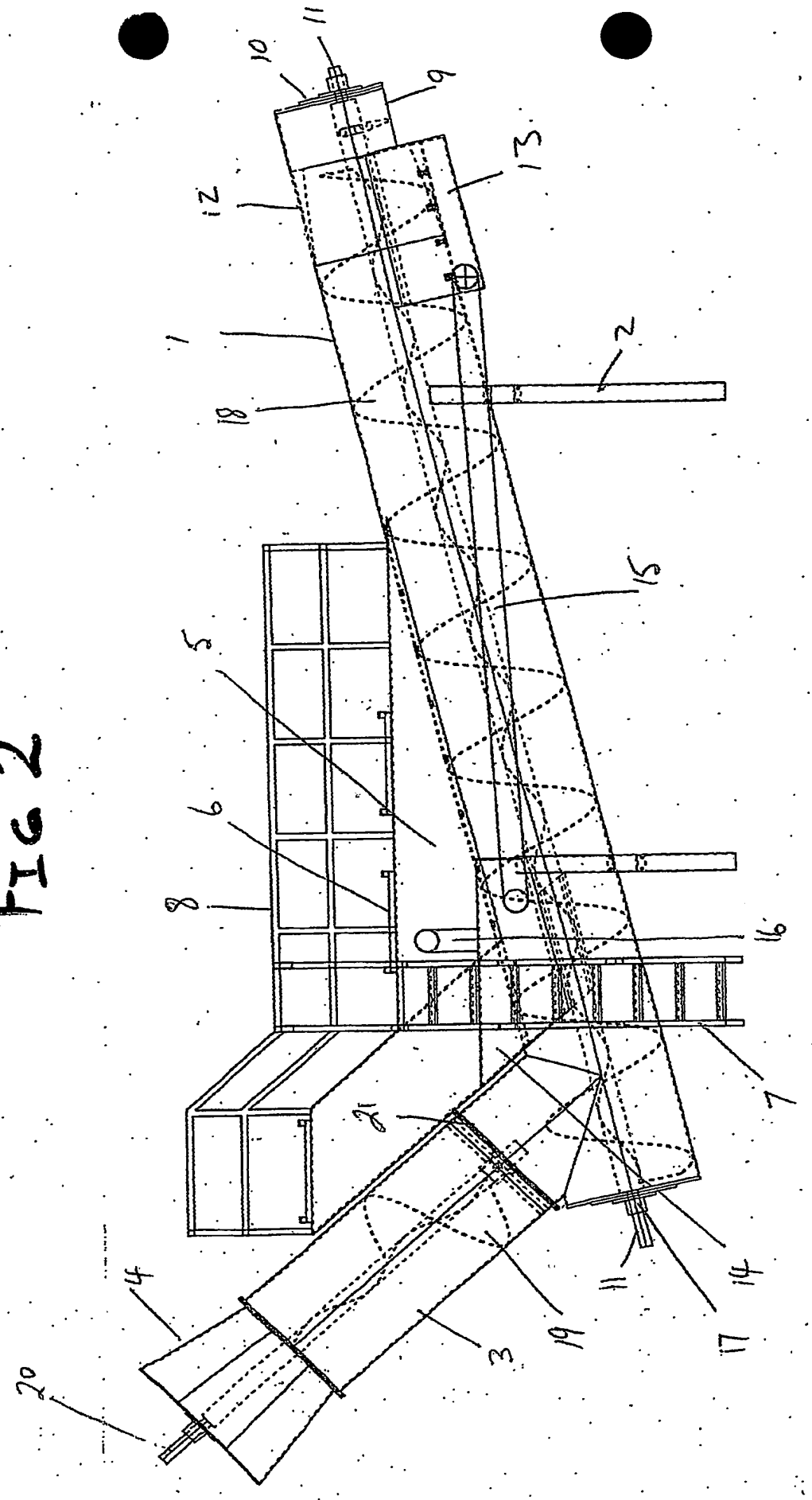
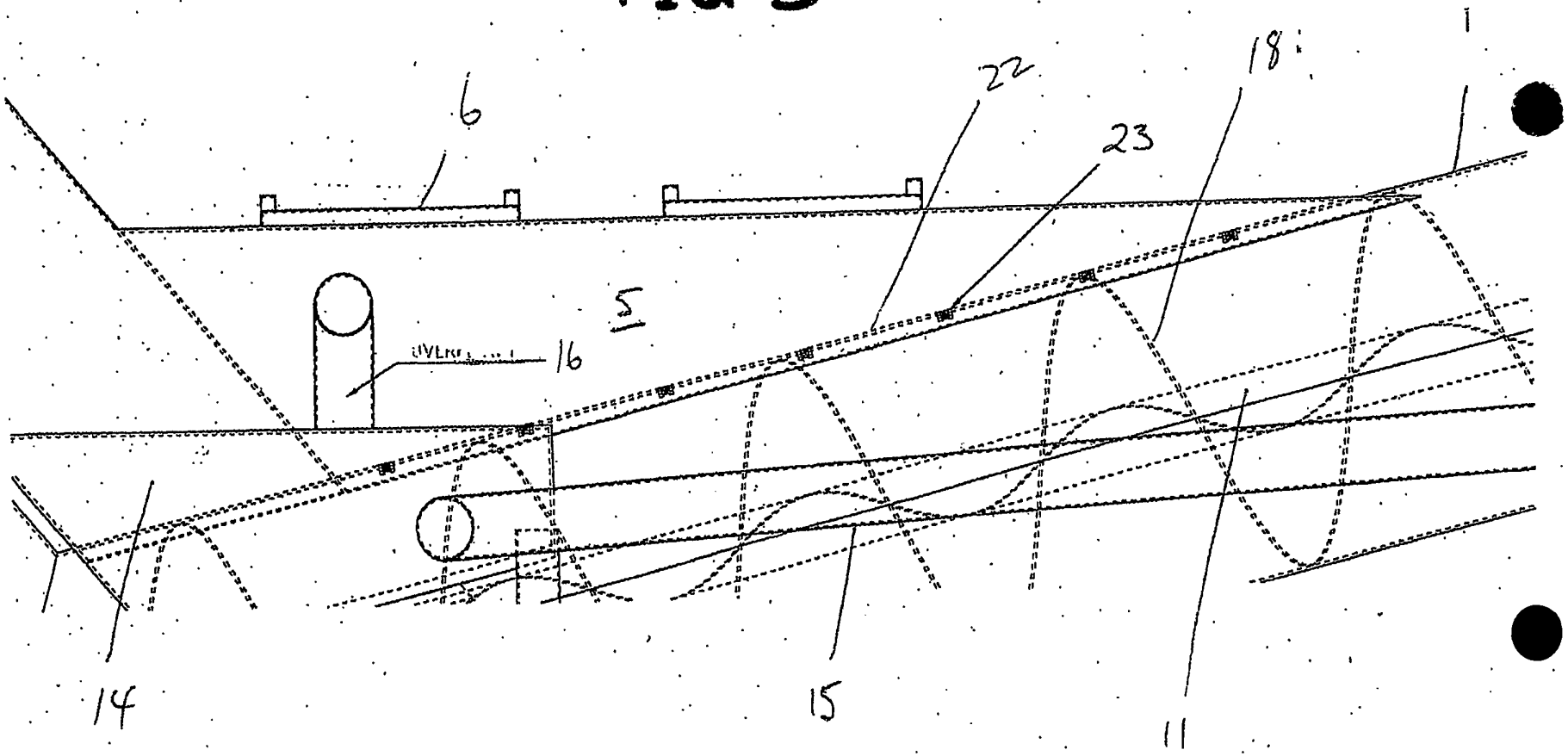


FIG 3



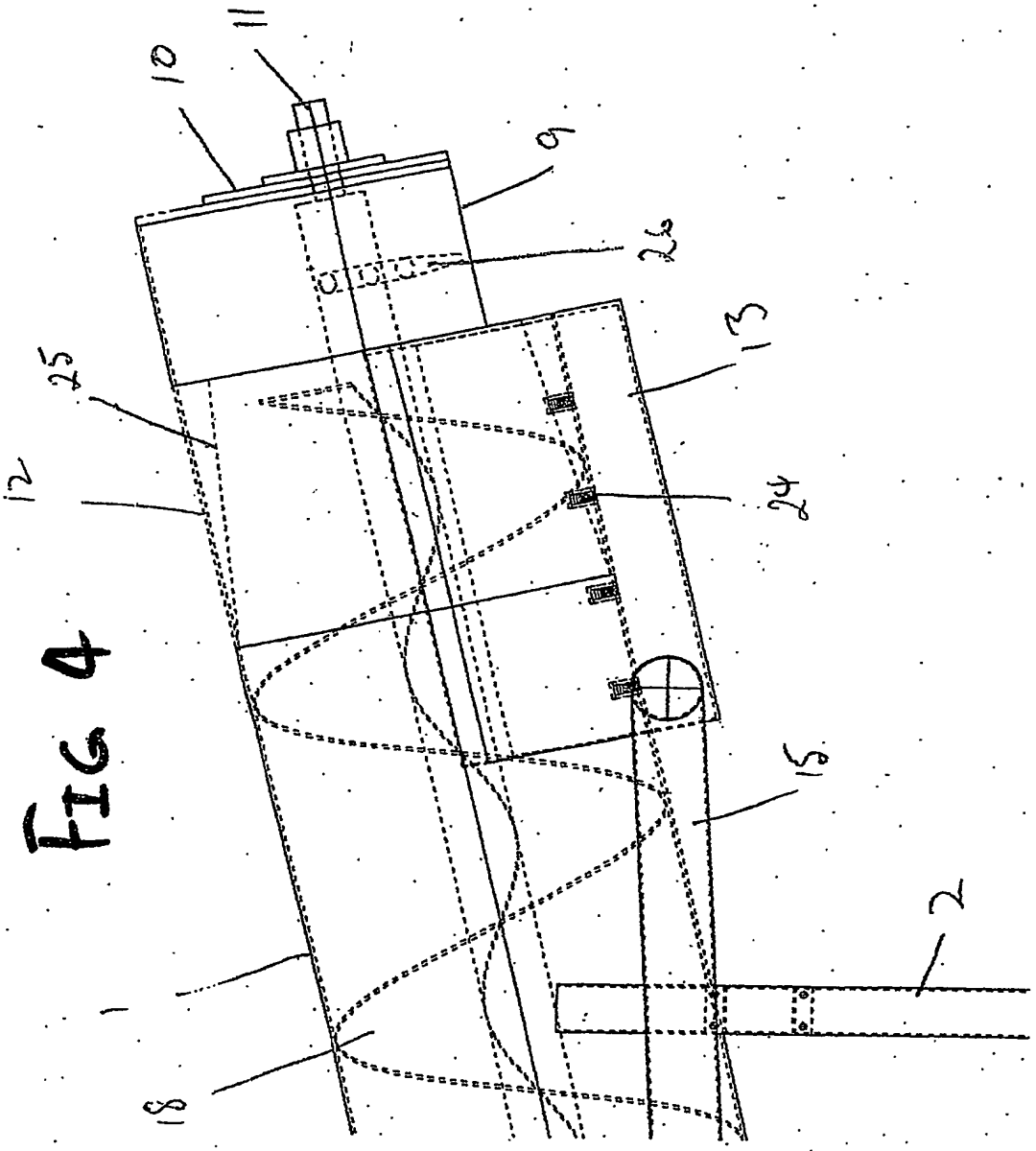


FIG 4